



Air Pollution Stunts Pines

PHOTO STORY No. 4

Chlorotic dwarf is one of the major problems in eastern white pine (Pinus strobus, L.) plantations. It's a disease that destroys chlorophyll, reducing the tree's food supply, turning it a sickly yellow color, and stunting its growth. Affected trees, crowded out by non-susceptible ones, usually die.

By monitoring the air in white pine plantations, a plant pathologist, L. S. Dochinger of the Forest Service's Forest Insect and Disease Laboratory at Delaware, Ohio, discovered that polluted air -- primarily low level atmospheric concentrations of sulfur dioxide and ozone, singly or in combination -- is the culprit. Dochinger also found that only certain trees possess the tendency to contract the disease, because this tendency is hereditary.

Since air pollution problems are extensive and not easily controlled, the intermediate aim of research at Delaware is to boost pollution-resistant white pine seedlings. Because non-susceptible pines do stay healthy in polluted air, and because disease characteristics can be detected in young nursery seedlings, programs for selecting and breeding resistant trees are possible.

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All of these white pine trees are 15 years old. Trees in the foreground display a wide range in susceptibility to the chlorotic dwarf disease, while those in the background are tolerant.

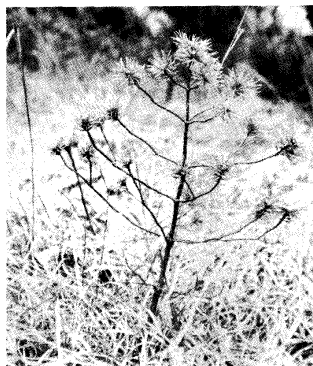


Industrial and car exhaust systems released 142 million tons of pollutants into the air over the United States during 1968. Eastern white pines are one of air pollution's victims. Low level atmospheric concentrations of sulfur dioxide and ozone in the air may cause chlorotic dwarf of white pines, a researcher at the Forest Service, USDA, Forest Insect and Disease Laboratory at Delaware, Ohio, discovered after several years of probing.

Chlorotic Dwarf Research Work

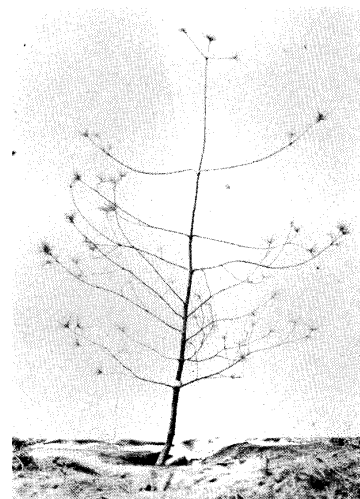
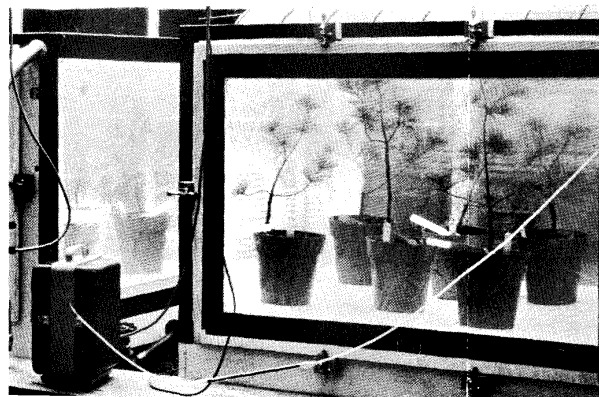


After three years of air filtration, charcoal cleansed chambers contained vigorous white pine trees.



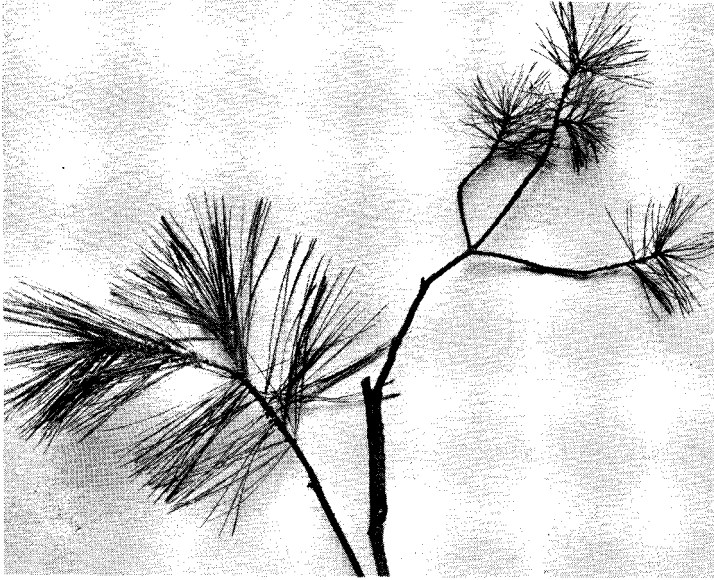
This tree is a chlorotic dwarf. At 8 years of age, it is only 18 inches tall, when it should be at least 10-15 feet high, and retains only its current crop of yellowed needles.

Scientists have wondered about chlorotic dwarfing for over 60 years. Once thought to be a foliage disorder, this condition threatens many white pines throughout the Midwest and Northeast. A Delaware scientist recently happened upon the idea that perhaps air in white pine plantations could hold the clue. To evaluate the possibility, he set up special chambers in the field whereby he was able to filter the ambient air, so as to allow only uncontaminated air to get into each chamber.



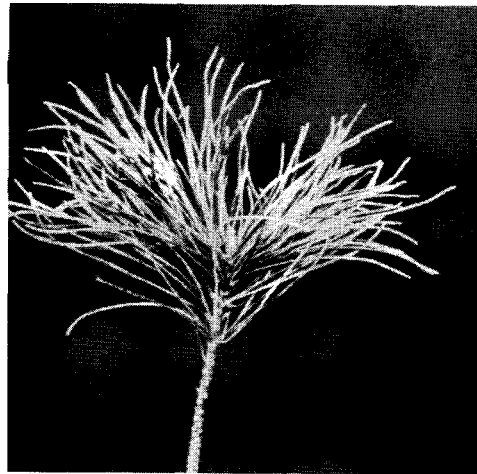
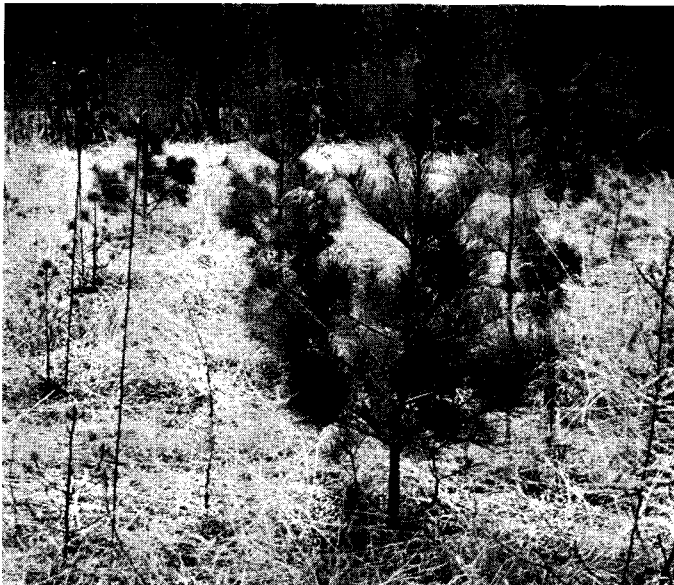
In order to determine to what extent concentrations of sulfur dioxide and ozone are correlated with the disease, special fumigation chambers were used in the greenhouse to expose susceptible and resistant white pines to purified and polluted air.

The Delaware scientist also selected plantation grown trees -- some resistant, some susceptible -- then grafted healthy and diseased scions onto other white pine plantation trees. These grafted shoots behaved exactly like their parents. Healthy grafted shoots continued to be vigorous, regardless of where grafted.



However, shoots from chlorotic dwarf (right), when grafted onto healthy trees, continued to be chlorotic in polluted air. Evidence from these tests supports the hypothesis that the susceptibility of white pine to chlorotic dwarf is an inherited, genetic characteristic.

An investigation to correlate juvenile characteristics with susceptibility to disease is under way. Preliminary findings indicate that certain characteristics of chlorotic dwarf show up in very young nursery seedlings, and that there is a positive correlation between seedling characteristics and subsequent disease development when outplanted. Needle mottling was an excellent characteristic for classifying this young pine as diseased.



When needle mottling was used as the criterion for disease classification, only 5 percent of the non-mottled seedlings later became chlorotic dwarf. One hundred percent of those marked mottled later became dwarfed. If susceptible trees -- including those that show the mottle characteristic -- are weeded out in the nursery, and only the apparently pollution-resistant ones selected for shipment to planting sites, the disease potential will be virtually kept out of future white pine plantations.